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PALACE Drifters and the Global Cellular Network

Final Project Report

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LONG-TERM GOAL

The long-term goal of this project was to design, build, and test a profiling float that can use the Iridium and Orbcomm global communication networks.

OBJECTIVES

Profiling floats have been used in recent years to study the upper ocean circulation throughout the world ocean, and there are future plans for several large experiments using these floats. At present these instruments communicate using the ARGOS system. However, this system is very slow (data transfer rates of only a few bits per second), and only one-way communication is possible. Both the Iridium and Orbcomm systems appeared when this work was proposed to be promising successors to ARGOS, and the objective of this work was to build a prototype PALACE and/or Orbcomm float capable of taking advantage of these new systems.

APPROACH

It was planned to build one or two floats that employ a prototype controller and communications module capable of using Iridium and Orbcomm. New antennas specific to Iridium and Orbcomm were to be developed.

WORK COMPLETED

The Iridium system came on line on 1 November 1998 and never became fully functional, owing to serious financial problems. The company declared bankruptcy in 1999 and ceased operations early in 2000. The company had said that it plans to turn on its data service (necessary to carry out this work) in October of 1999, but this service was never turned on. Now, in mid-2001, Iridium is again functional, thanks to funds provided by the Department of Defense. But for purposes of this grant it is too late to take advantage of this development. We were somewhat more successful in building a float capable of using the Orbcomm system. The communications portions of the float were tested late in 1999 and during a January, 2000 cruise of the R/V *Thomas G. Thompson* between San Diego and Hawaii. The tests went well. However, Orbcomm, too, has declared Chapter 11 bankruptcy and it is not clear that the system will ever be financially viable. For that reason, we did not proceed further with our testing and development program.

RESULTS

We tested the voice component of the Iridium system by transmitting short data packets from the top of the Oceanography building at UW. We did this using a signal generator, Iridium handsets, and an acoustic modem. We found that it was impossible to send data via the voice component, although voice communications were satisfactory. Thus, we were able to go no further with Iridium until the data system was turned on. Unfortunately this never happened, although in our discussions with Iridium we were promised on several occasions that functionality of the data system was imminent. Before this actually occurred, however, the company declared bankruptcy and ceased operations. We were more successful using the Orbcomm system. Using a transmitter mounted on the *R/V Thomas G. Thompson* during a transit from San Diego to Honolulu and another on the roof of a building at UW, we spent nearly 11 days sending and receiving synthetic float data to and from the ship and our laboratory at UW. This worked well. While the ship was within roughly 1000 miles of the US mainland, we communicated in "bent-pipe" mode; at greater distances, we were successful in communicating using "store-and-forward" mode. It appeared from our tests that Orbcomm could offer throughput that is about 6-8 times faster than the Argos system. Unfortunately, a few months later the company declared Chapter 11 bankruptcy and now has a very uncertain future. But in addition to the financial problems, we found two other problems with Orbcomm that potentially limit its suitability for use in the oceanographic community. First, the cost of Orbcomm service is unknown, and we were never able to get a firm cost estimate from the company. During our tests, the price was quite reasonable, only about 8¢ per kilobyte of data transmitted or received. But we were told that this price probably would not continue for more than 6 months. To be financially practical, Orbcomm told us that they might have to charge as much as 10 times this amount. At 80¢ per kilobyte, the system is possibly too expensive for use in the oceanographic community. Secondly, it became clear from our tests that Orbcomm would probably not be very useful for 2-way communications. In a one-way mode the system operates similar to, but faster than, Argos. But in 2-way mode, Orbcomm communication is not instantaneous (had it been available, 2-way communications with Iridium would have been essentially instantaneous, modem-to-modem communications). Instead, the system treats the 2-way communication as 2 one-way information transfers, and between each transfer the system must choose which satellite to use. The user must know which satellite will be near the float when the data is transmitted and send a message to the system telling it which satellite to use. This is a cumbersome requirement and greatly limits the usefulness of Orbcomm for use with nonstationary platforms such as drifting floats.

IMPACT/APPLICATION

Profiling floats have a good future as a tool for ocean exploration, and also in many applied areas such as ocean prediction. The relatively high-speed, 2-way communication link planned here would have greatly improved our ability to use these floats in exploring the world ocean in programs such as Argo, but also in many other programs and with many other types of instruments.

TRANSITIONS

None.

RELATED PROJECTS

I have been funded by ONR for the past several years for a profiling float program in the Japan Sea. Additionally, I am a member of the US Argo Consortium and a member of the International Argo Science Team and am deploying floats as part of Argo (results from both experiments can be seen at <http://flux.ocean.washington.edu>). Using Iridium and Orbcomm technology instead of ARGOS would have been useful in both of these efforts. It is hoped that in the future there will still be the opportunity for a high-speed, 2-way alternative to Argos. Perhaps the reborn Iridium system will fill this need.